

# PATENT SPECIFICATION

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## DRAWINGS ATTACHED

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## (54) IMPROVEMENTS RELATING TO FRICTION GRIP BOLTED JOINTS AND TO A METHOD OF ASSEMBLY THEREOF

(71) We, LICENCIA TALAMANYOKAT ERTEKESITO VALLALAT, a Hungarian Body Corporate, of Jozef nador ter 10, Budapest V, Hungary, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

10 This invention relates to improved friction grip bolted joints (sometimes known as high strength friction grip bolted joints) and to methods of making such joints.

15 Friction grip bolted joints comprising two or more structural elements bolted together are characterized in that shearing loads are not transmitted from one element to the next by shear in the bolt or bolts. In known friction grip bolted joints shearing loads are transmitted from one structural element to the next entirely by friction. By using high strength bolts the structural elements can be pressed tighter together and can withstand a higher shearing load before the structural elements slip relative to one another and bear on the side of the bolt or bolts. The advantages of such joints, which are increasingly supplanting conventional methods of joining metal structures, such as riveting and welding, are the saving of material, simpler and more economic assembly, and a greater fatigue strength compared with the aforesaid conventional methods of joining.

25 At present, the design procedures for friction grip bolted joints are not entirely acceptable. This is partly because the net section tension stresses are not directly proportional to the external load applied but, instead, as a result of slide and flow processes, show a characteristic polygonal system having varying stress distribution.

30 Design uncertainties such as the large scatter of the values of slip factors obtained with the untreated surfaces, flame-treated surfaces and sand-blasted surfaces hitherto

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used frequently lead to excessive overdimensioning or underdimensioning.

The present invention provides a friction grip bolted joint which can more accurately be designed and which can be constructed to withstand higher stresses applied to the structural elements perpendicular to the axis of the bolts than is possible with friction grip bolted joints used hitherto.

According to the present invention, there is provided a friction grip bolted joint including at least two structural elements and a multiplicity of shear-resisting elements therebetween which elements are constituted by surface irregularities of the contact surfaces of said structural elements and are effective to transmit shear load across their shear-areas, and wherein the  $R_s$  (as hereinbefore defined) of the said surface irregularities within a sampling length of 2.5 mm is at least 100  $\mu\text{m}$ .

The exact size of the shear-area of the shear-resisting elements in a joint according to the invention will of course of unknown. The transmitting of load from one structural element of the joint to the other is effected through the shear-resisting elements as well as by friction.

The shear-resisting elements may conveniently be formed mechanically, for example by indentation of the said contact surfaces with a pneumatic punching tool.

The present invention also provides a method of forming a friction grip bolted joint between at least two structural elements as set forth above, which method comprises the steps of treating the intended contact surfaces of said structural elements to form surface irregularities providing a multiplicity of shear-resisting elements, the  $R_s$  (as herein-after defined) of the said surface irregularities within a sampling length of 2.5 mm being at least 100  $\mu\text{m}$ , and bolting together the said structural elements so tightly as to form a friction grip bolted joint.

An embodiment of the present invention

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will now be described by way of example and with reference to the accompanying drawing which shows, on an enlarged scale, a section through a part of a contact surface 5 of a structural element for use in a joint according to the invention, after treatment with a pneumatic punching tool.

Referring to the drawing, shear-resisting elements are formed on the contact surfaces 10 of the structural elements of the joint by mechanical treatment of the base material of each structural element, for example by indentation with a pneumatic punching tool. It is of course, impracticable or even 15 impossible to determine the size of the shear-

resisting elements. However the applicants have found that the load capacity of the friction grip bolted joints increases at least 30 per cent, on average 50 per cent, as compared to the friction grip bolted joints hitherto used, by mechanically treating the contact surfaces so that the roughness ( $R_z$ ) of the surfaces obtained corresponds to a value of at least  $100 \mu\text{m}$  within a sampling length of 2.5 mm, as defined by International Organization for Standardization, Ref. No. ISO/R 468—1966 (E). According to this definition and referring to the drawing:—

$$R_z = \frac{(h_1 + h_2 + h_3 + h_4 + h_5) - (h_6 + h_7 + h_8 + h_9 + h_{10})}{5}$$

For our purposes:—

$R_z \geq 100 \mu\text{m}$  ( $\approx 0.004$  inch).

By comparison, surfaces flame treated or sand blasted and prepared in accordance with 35 German specifications for friction grip bolted joints have a roughness, determined by the values of  $R_z$  described above, which is at least of 2.5 times less than those according to the invention.

The shear-resisting elements formed from 40 the material of the joint itself by the mentioned mechanical treatment have also a higher ultimate tensile strength than that of the base material because these treatments 45 harden the surfaces too.

According to applicants' measurements, the described mechanical treatment by means of a pneumatic punching tool requires only about 20 per cent of time of flame treating.

The increase of load capacity of the friction grip bolted joints according to the invention 50 also permits a reduction of the number of expensive high strength bolts.

The use in metal structures of the friction grip bolted joints according to the invention results, besides the described substantial increase of load capacity, in a minimum scatter of slip factors and thus a more predictable load capacity. It is simpler than 55 the surface treatment hitherto used and so does not require skilled workers. Its correct performance can easily be controlled.

#### WHAT WE CLAIM IS:—

1. A friction grip bolted joint including 65 at least two structural elements and a multiplicity of shear-resisting elements therebetween which elements are constituted by

surface irregularities of the contact surfaces of said structural elements and are effective to transmit shear load across their shear-areas, and wherein the  $R_z$  (as hereinbefore defined) of the said surface irregularities within a sampling length of 2.5 mm is at least  $100 \mu\text{m}$ .

2. A friction grip bolted joint according to claim 1, wherein the ultimate tensile strength of the said shear-resisting elements is higher than that of the base ematerial of the said structural elements.

3. A friction grip bolted joint substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

4. A method of forming a friction grip bolted joint between at least two structural elements as claimed in claim 1, which method comprises the steps of treating the intended contact surfaces of said structural elements to form surface irregularities providing a multiplicity of shear-resisting elements, the  $R_z$  (as hereinbefore defined) of the said surface irregularities within a sampling length of 2.5 mm being at least  $100 \mu\text{m}$ , and bolting together the said structural elements so tightly as to form a friction grip bolted joint.

5. A method according to claim 4, wherein the said contact surfaces are so treated that the ultimate tensile strength of the said shear-resisting elements is higher than that of the base material of the said structural elements.

6. A method according to claim 4 or 5 wherein the said shear-resisting elements are formed from the said contact surfaces by indenting said surfaces mechanically.

7. A method according to claim 6, wherein

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said indenting is carried out with a pneumatic punching tool.

8. A method of forming a friction grip bolted joint between two structural elements, substantially as hereinbefore described with reference to the accompanying drawing.

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
the Original on a reduced scale*

